

Amendments to the Claims: This listing of claims will replace all prior versions, and listings, of claims in the application

Listing of Claims:

1. (Cancelled)
2. (Cancelled)
3. (Cancelled)
4. (Cancelled)
5. (Cancelled)
6. (Cancelled)
7. (Cancelled)
8. (Cancelled)
9. (Cancelled)
10. (Cancelled)
11. (Cancelled)
12. (Cancelled)

13. (Currently Amended) An audio decoding device ~~according to claim 9 for~~ decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section, wherein:

the first memory section comprises, in addition to the first memory area and the second memory area, a third memory area for storing data not limited to use with the sub-band synthesis operation; and

the operation section comprises a sub-band signal transfer section for, when a number of channels of input encoded audio data is three or greater, copying or transferring at least some of the sub-band signals for a particular channel stored in the first memory section to a particular area in the first memory section.

14. (Currently Amended) An audio decoding device ~~according to claim 9 for~~ decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data

calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising a sub-band signal addition/subtraction section for performing addition and subtraction of the sub-band signals, in parallel with a transfer operation for the sub-band synthesis filter data from the second memory section to the first memory section after the encoded audio data has been input and decoded into sub-band signal data.

15. (Currently Amended) An audio decoding device ~~according to claim 9 for~~ decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising an interleave section for taking samples of decoded data decoded by the sub-band synthesis operation, one sample from each of the

channels, and rearranging the samples in a predetermined order, in parallel with a transfer operation for the sub-band synthesis filter data from the first memory section to the second memory section after a sub-band synthesis operation for a final channel has been completed.

16. (Original) An audio decoding device according to claim 15, the interleave section comprising an interleave division section for dividing an interleave operation into r steps (where $r \geq 2$).

17. (Original) An audio decoding device according to claim 15, the interleave section comprising an interleave storage area selection section for selecting a data storage area in the first memory section to be used for an interleave operation depending on whether a number of channels to be decoded by the sub-band synthesis operation is even or odd.

18. (Currently Amended) An audio decoding device ~~according to claim 11 for~~ decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section.

the operation section comprising a continuous transfer instruction section for instructing, when instructing a data transfer operation between the first memory section and the second memory section, a plurality of data transfer operations with a single issuance of instruction,

the continuous transfer instruction section comprising a specific data transfer completion detection indication section for indicating detected completion of a p'th transfer operation out of q (where: $q > 1$; and $1 \leq p < q$) data transfer operations performed between the first memory section and the second memory section.

19. (Original) An audio decoding device according to claim 18, the data transfer section comprising a specific data transfer completion detection transmission section for detecting completion of a p'th transfer operation out of q data transfer operations performed between the first memory section and the second memory section as instructed by the continuous transfer instruction section and for transmitting to the operation section the detected completion of the p'th transfer operation.

20. (Currently Amended) An audio decoding device ~~according to claim 11, wherein:~~
for decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising:

a continuous transfer instruction section for instructing, when instructing a data transfer operation between the first memory section and the second memory section, a plurality of data transfer operations with a single issuance of instruction; and

~~the operation section comprises~~ a specific data transfer completion detection section for detecting completion of a p 'th transfer operation out of q data transfer operations performed between the first memory section and the second memory section as instructed by the continuous transfer instruction section; ~~and,~~

wherein the operation section performs an s 'th one of the r (where: $r \geq 2$; and $2 \leq s \leq r$) steps of the interleave operation after the specific data transfer completion detection section detects completion of a data transfer operation for a specific area.

21. (Currently Amended) An audio decoding device ~~according to claim 11, for~~ decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising a continuous transfer instruction section for instructing, when instructing a data transfer operation between the first memory section and the second memory section, a plurality of data transfer operations with a single issuance of instruction, wherein:

the continuous transfer instruction section comprises a PCM data transfer instruction section for instructing a transfer operation of at least one channel of decoded PCM data between the first memory section and the second memory section when a number of channels of input decoded data decoded by the sub-band synthesis operation is t (where $t \geq 3$); and

the PCM data transfer instruction section temporarily transfers PCM data, for which the sub-band synthesis operation has been performed, from the first memory section to the second memory section and re-transfers PCM data which has been transferred to the second memory section to the first memory section in parallel with a sub-band synthesis operation for a final channel.

22. (Currently Amended) ~~An audio decoding device according to claim 11, for~~
decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data

calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising a continuous transfer instruction section for instructing, when instructing a data transfer operation between the first memory section and the second memory section, a plurality of data transfer operations with a single issuance of instruction,

the continuous transfer instruction section comprising a PCM data storage area selection section for selecting a storage area in the first memory section to be used for a transfer operation of PCM data from the second memory section to the first memory section performed in parallel with a sub-band synthesis operation for a final channel depending on whether a number of channels of input decoded data decoded by the sub-band synthesis operation is even or odd.

23. (Currently Amended) ~~An audio decoding device according to claim 9 for~~
decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing M_A (where $M_A < N_A$) channels of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing at least some of N_A channels of sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output M_A channels of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by M_A channels, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section, wherein:

the operation section comprises a division decoding section for dividing decoding processes from sub-band signal generation to output signal generation, or decoding processes from sub-band synthesis to output signal generation, so as to equally divide a number of audio output signal samples per frame into y blocks; and

$a = b \times c \times y$, where a denotes the number of audio output signal samples per frame for each channel of encoded audio signals, b denotes a number of sub-bands of the encoded audio signals, and c denotes a number of samples to be generated while processing one block.

24. (Cancelled)

25. (Currently Amended) An audio decoding device according to claim 24 for decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing at least one channel of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output one channel of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by one channel, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising a continuous transfer instruction section for, when instructing a data transfer operation between the first memory section and the second memory section, instructing a plurality of data transfer operations with a single issuance of instruction.

26. (Original) An audio decoding device according to claim 25, the operation section comprising a virtual addresses following an actual address at a termination point of the memory area in the first memory section which stores the sub-band synthesis filter data, allocating a start point of the virtual addresses to a predetermined actual address in the memory area, and sequentially allocating other ones of the virtual addresses to actual addresses.

27. (Currently Amended) An audio decoding device ~~according to claim 24 for~~ decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing at least one channel of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output one channel of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by one channel, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section, wherein:

the first memory section comprises, in addition to the first memory area and the second memory area, a third memory area for storing data not limited to use with the sub-band synthesis operation; and

the operation section comprises a sub-band signal transfer section for, when a number of channels of input encoded audio data is three or greater, copying or transferring at least some of the sub-band signals for a particular channel stored in the first memory section to a particular area in the first memory section.

28. (Currently Amended) An audio decoding device ~~according to claim 24~~ for decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing at least one channel of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output one channel of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by one channel, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising a sub-band signal addition/subtraction section for performing addition and subtraction of the sub-band signals, in parallel with a transfer operation for the sub-band synthesis filter data from the second memory section to the first memory section after the encoded audio data has been input and decoded into sub-band signal data.

29. (Currently Amended) An audio decoding device ~~according to claim 24~~ for decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing at least one channel of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output one channel of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by one channel, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section,

the operation section comprising an interleave section for taking samples of decoded data decoded by the sub-band synthesis operation, one sample from each of the channels, and rearranging the samples in a predetermined order, in parallel with a transfer operation for the sub-band synthesis filter data from the first memory section to the second memory section after a sub-band synthesis operation for a final channel has been completed.

30. (Original) An audio decoding device according to claim 29, the interleave section comprising an interleave division section for dividing an interleave operation into r steps (where $r \geq 2$).

31. (Original) An audio decoding device according to claim 29, the interleave section comprising an interleave storage area selection section for selecting a data storage area in the first memory section to be used for an interleave operation depending on whether a number of channels to be decoded by the sub-band synthesis operation is even or odd.

32. (Original) An audio decoding device according to claim 25, the continuous transfer instruction section comprising a specific data transfer completion detection

indication section for indicating detected completion of a p 'th transfer operation out of q (where: $q > 1$; and $1 < p < q$) data transfer operations performed between the first memory section and the second memory section.

33. (Original) An audio decoding device according to claim 32, the data transfer section comprising a specific data transfer completion detection transmission section for detecting completion of a p 'th transfer operation out of q data transfer operations performed between the first memory section and the second memory section as instructed by the continuous transfer instruction section and for transmitting to the operation section the detected completion of the p 'th transfer operation.

34. (Original) An audio decoding device according to claim 25, wherein:

the operation section comprises a specific data transfer completion detection section for detecting completion of a p 'th transfer operation out of q data transfer operations performed between the first memory section and the second memory section as instructed by the continuous transfer instruction section; and

the operation section performs an s 'th one of the r (where: $r \geq 2$; and $2 \leq s \leq r$) steps of the interleave operation after the specific data transfer completion detection section detects completion of a data transfer operation for a specific area.

35. (Original) An audio decoding device according to claim 25, wherein:

the continuous transfer instruction section comprises a PCM data transfer instruction section for instructing a transfer operation of at least one channel of decoded PCM data transfer instruction section for instructing a transfer operation of at least one channel of decoded PCM data between the first memory section and the second memory section when a number of channels of input decoded data decoded by the sub-band synthesis operation is t (where $t \geq 3$); and

the PCM data transfer instruction section temporarily transfers PCM data, for which the sub-band synthesis operation has been performed, from the first memory section to the second memory section and retransfers PCM data which has been transferred to the second memory section to the first memory section in parallel with a sub-band synthesis operation for a final channel.

36. (Original) An audio decoding device according to claim 25, the continuous transfer instruction section comprising a PCM data storage area selection section for selecting a storage area in the first memory section to be used for a transfer operation of PCM data from the second memory section to the first memory section performed in parallel with a sub-band synthesis operation for a final channel depending on whether a number of channels of input decoded data decoded by the sub-band synthesis operation is even or odd.

37. (Currently Amended) An audio decoding device according to claim 24 for decoding N_A (where $N_A > 1$) channels of audio signals by a sub-band synthesis operation using sub-band synthesis filter data and sub-band signal data, the device comprising:

a first memory section for storing at least one channel of the sub-band synthesis filter data and the sub-band signal data used for the sub-band synthesis operation;

a second memory section for storing sub-band signal data and N_A channels of sub-band synthesis filter data;

an operation section for receiving encoded audio data and decoding the encoded audio data into sub-band signal data, performing a sub-band synthesis filter operation using the data stored in the first memory section so as to output one channel of decoded audio data, and requesting to switch positions of new sub-band synthesis filter data calculated by the sub-band synthesis filter operation and next sub-band synthesis filter data required; and

a data transfer section for, based on the request from the operation section, switching, by one channel, the sub-band synthesis filter data and the sub-band signal data in the first memory section and the second memory section, wherein:

the operation section comprises a division decoding section for dividing decoding processes from sub-band signal generation to output signal generation, or decoding processes from sub-band synthesis to output signal generation, so as to equally divide a number of audio output signal samples per frame into y blocks; and

$a = b \times c \times y$, where a denotes the number of audio output signal samples per frame for each channel of encoded audio signals, b denotes a number of sub-bands of the

Appln. No.: 09/593,056
Amendment Dated: September 14, 2005
Reply to Office Action of June 9, 2005

YAO-3900US1

encoded audio signals, and c denotes a number of samples to be generated while processing one block.